

## CLAIMS

What is claimed is:

1. A control device for a permanent magnet synchronous motor, comprises:

5        an inverter for converting input DC voltage into alternating current of variable voltage and variable frequency, and for driving the motor with the alternating current;

10        a *q*-axis current instructing means for generating, in accordance with a speed instruction signal, an instruction signal for a *q*-axis component of the current, orthogonal to the magnetic field of the motor;

      a loss calculating means for calculating a loss that is the sum of the motor's copper loss and iron loss;

15        a *d*-axis current generating means for generating, in accordance with the motor's rated loss decreased by the loss, an instruction signal for a *d*-axis current that is passed through the motor;

20        a controlling means for judging, from the DC voltage, whether or not the motor is operating in a recovery state, and for activating the *d*-axis current generating means if the motor is in the recovery state.

2. A control device for a permanent magnet synchronous motor, comprises:

25        an inverter for converting input DC voltage into

alternating current of variable voltage and variable frequency, and for driving the motor with the alternating current;

5 a  $q$ -axis current instructing means for generating, in accordance with a speed instruction signal, an instruction signal for a  $q$ -axis component of the current, orthogonal to the magnetic field of the motor;

10 a  $d$ -axis current generating means for generating an instruction signal for a  $d$ -axis current with the same directionality as the magnetic field of the motor;

a storage means for storing inputted values of the motor's winding resistance, field magnetic flux constant, and rated loss;

15 a current detecting means for detecting current flowing in the motor, so as to generate a current detection signal;

a position detecting means for detecting a rotational position of the motor, so as to generate a position detection signal;

20 a calculating means for calculating, based on the current detection signal and the winding resistance, the motor's copper loss, and calculating, based on the position detection signal and the field magnetic flux constant, the motor's iron loss, so as to calculate a loss that is the  
25 sum of the copper loss and the iron loss;

a *d*-axis current generating means for generating, based on the motor's rated loss decreased by the loss calculated by the calculating means, an instruction signal for the *d*-axis current; and

5           a controlling means for judging, from the DC voltage, whether or not the motor is operating in a recovery state, and for activating the *d*-axis current generating means if the motor is in the recovery state.

3. A control device for a permanent magnet synchronous  
10 motor, comprises:

an inverter for converting input DC voltage into alternating current of variable voltage and variable frequency, and for driving the motor with the alternating current;

15           a *q*-axis current instructing means for generating, in accordance with a speed instruction signal, an instruction signal for a *q*-axis component of the current, orthogonal to the magnetic field of the motor;

20           a *d*-axis current generating means for generating an instruction signal for a *d*-axis current with the same directionality as the magnetic field of the motor;

a storage means for storing inputted values for the motor's winding resistance, field magnetic flux constant, rated loss, and thermal time constant;

25           a current detecting means for detecting current

flowing in the motor, so as to generate a current detection signal;

a position detecting means for detecting rotational position of the motor, so as to generate a position detection  
5 signal;

an iron loss calculating means for calculating, based on the current detection signal and the winding resistance, the motor's copper loss, and calculating, based on the position detection signal and the field magnetic flux  
10 constant, the motor's iron loss, so as to calculate a loss value that is the sum of the copper loss and the iron loss;

an estimating means for estimating temperature rise in the motor windings based on the loss calculated by the loss calculating means, and on the thermal time constant;

15 a d-axis current generating means for generating, in accordance with the estimated temperature rise, an instruction signal for flowing the d-axis current to the motor; and

a controlling means for judging, from the DC voltage,  
20 whether or not the motor is operating in a recovery state, and for activating the d-axis current generating means if motor is in the recovery state.

4. A permanent magnet synchronous motor control device according to any one of claims 2 to 3, wherein the  
25 inverter is provided with a d-axis current limiting means

for restricting the *d*-axis current instruction signal based on the maximum current that the inverter is capable of flowing.

5        5. A permanent magnet synchronous motor control device according to any one of claims 2 to 3, wherein the control device further comprises:

        a recovery consumption means that includes a resistor and a switching device to be connected to the direct voltage; and

10        an activating means that judges whether or not the direct voltage exceeds a predetermined threshold value, and activates the switching device when it exceeds the value.

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